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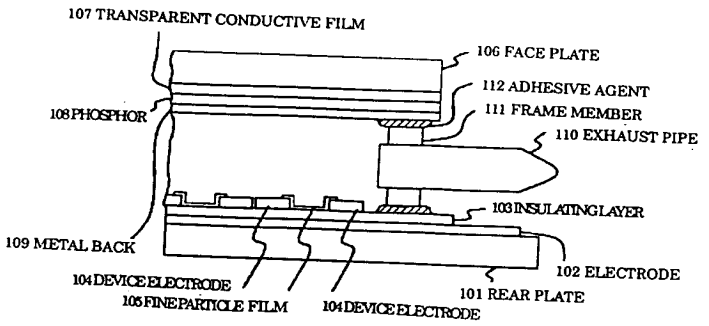
(54) [Title of the Invention] Manufacturing Method of Image Display Apparatus

(57) [Abstract]
[Object of the Invention]
The object of the present invention is to realize a manufacturing method of an image display apparatus of sufficient outgas at a time of vacuum exhaustion. Also the object of the present invention is to realize a manufacturing method of an image display apparatus of capability to increase image quality of an image display apparatus and of long life.
[Constitution]

A manufacturing method of an image display apparatus comprising;

a first process for baking an envelope and to vacuum exhaust via an exhaust pipe at the same time, the envelope including the exhaust pipe which communicates to outside and in which image display members are disposed; and



a second process for sealing the exhaust pipe to maintain vacuum of the inner space after the vacuum exhaustion by the first process,

wherein a temperature for baking the exhaust pipe in the first process is a temperature for baking the envelope or higher.

[Claims]

[Claim 1]

A manufacturing method of an image display apparatus comprising;

a first process for baking an envelope and to vacuum exhaust via an exhaust pipe at the same time, the envelope including the exhaust pipe which communicates to outside and in which image display members are disposed; and

a second process for sealing the exhaust pipe to maintain vacuum of the inner space after the vacuum exhaustion by the first process,

wherein a temperature for baking the exhaust pipe in the first process is a temperature for baking the envelope or more.

[Claim 2]

The manufacturing method of the image display apparatus described in claim 1, where the baking temperature of the exhaust pipe is same as the softening point of the exhaust pipe or lower.

[Detail Description of the Present Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a manufacturing method of a flat

type image display apparatus, particularly a manufacturing method of a flat type image display apparatus using a surface conductive electron emitting device.

[Prior arts]

Conventionally, an image display apparatus which displays by excitation of phosphor such as a vacuum fluorescent display tube performing an image forming, a plasma display, a display apparatus using an electron beam generating apparatus of spindt type of field emission type and a display apparatus using a classic and conventional surface conductive electron emitting device has advantages in its flat surface, brightness and easiness to watch.

[0003]

As an example, Fig. 5 shows a conventional vacuum fluorescent display tube, Fig. 6 shows a conventional plasma display.

[0004]

The vacuum fluorescent display tube shown in Fig. 5 has a rear plate 521 and a face plate 528 disposed opposing to each other. An insulating film 534, electrodes 522 and 523, a phosphor 524 and a display portion 525 are provided on the rear plate 521. A transparent conductive film 529 is provided on the surface of the face plate 628 facing the rear plate 521. Also, a grid 526 and a filament 527 are provided between the rear plate 521 and the face plate 528.

[0005]

The plasma display shown in Fig. 6 has a rear plate 621 and a face plate 628 disposed opposing to each other. An electrode 623, an insulating film 634 and an electrode 622 are sequentially provided on the rear plate 621 to the direction of the face plate 628. A transparent conductive film 629 and a phosphor 624 are sequentially provided on the face plate 628 to the direction of the rear plate 621.

[0006]

In the vacuum fluorescent display tube and the plasma display respectively shown in Fig. 5 and Fig. 6, the rear plates 521, 621 and the face plates 528, 628 are integrally adhered by frame members 533, 633 and adhesive agent 532, 632 so as to seal the inside. In the vacuum fluorescent display tube as shown in Fig. 5, a lead wire 530 for communicating an ex-

ternal signal is connected to the electrode 522 through the adhesive agent 531.

[0007]

With regard to a manufacturing method, the electrodes 522, 523, 622, 623 and the insulating films 534, 634 are formed on the rear plates 521, 621 of the vacuum fluorescent display tube shown in Fig. 5 and the plasma display shown in Fig. 6. In the vacuum fluorescent display tube shown in Fig. 5, the grid 526 and the filament 527, etc. are formed as control electrodes. Subsequently, the transparent conductive films 529, 629 and the phosphor 524, 624 are formed on the face plates 528, 628, and exhaust pipes 531, 631 are formed on the frame members 533, 633. The rear plates 521, 621, the frame members 533, 633 and the face plates 528, 628 are laminated via the adhesive agent 532, 632. By performing baking and pressurization simultaneously, an envelope is formed. The envelope is airtight adhered by the rear plates 521, 621, the face plates 528, 628, the frame members 533, 633 and the adhesive agent 532, 632 so as to seal inside.

[0008]

Subsequently, the envelope formed as mentioned above is sealed. Fig. 7 is a view to show the status of a heating processing to be performed at sealing.

[0009]

As shown in Fig. 7, an image display apparatus 736, which is the envelope manufactured as mentioned above, is disposed on a heating device 735. Then, the image display apparatus 736 is baked by the heating device 735, and inner air is vacuum exhausted by an exhaust pipe 731 simultaneously, thus forming a desired vacuum level and ambient atmosphere. The exhaust pipe is further heated to be fused and sealed, thus manufacturing the image display apparatus.

[0010]

[Problems to be Solved by the Invention]

However, in the manufacturing method of the image display apparatus such as the above-mentioned conventional vacuum fluorescent display tube and plasma display, the exhaust pipe is baked together with the image display apparatus in the heating processing of the image displa- apparat- a

This heating processing is performed at the time of vacuum exhaustion of the inner air of the image display apparatus. After the heating processing, the exhaust pipe is further heated to the melting temperature for sealing. Accordingly, the inner air of the image display apparatus may be vacuum exhausted to form a desired ambient atmosphere before the exhaust pipe is sufficiently baked, and the exhaust pipe may be sealed. In such a case, the manufactured image display apparatus has the following problems.

[0011]

(1) Since the vacuum level in the image display apparatus reduces by outgas from the exhaust pipe, a withstand voltage when a high voltage applied between the rear plate and the face plate reduces. Discharge and the like occur in the image display apparatus, and as a result the apparatus is deteriorated and fractured. Such a problem is specifically conspicuous in a very thin flat type image display apparatus which has a small distance between the rear plate and the face plate. The problem is also conspicuous in a flat type image display apparatus which requires forming of a high luminescence light emission portion by applying a high voltage.

[0012]

(2) Since the ambient atmosphere in the image display apparatus changes by the outgas from the exhaust pipe, a drive starting voltage of the apparatus changes, thus deteriorating the durability.

[0013]

Because of the above-mentioned problems, when the image display apparatus is driven and is operated, not only the quality of a displayed image is reduced as passage of time, but also an abnormal charge and the like occur. In the worst case, a problem of the image display apparatus failure will occur.

[0014]

The present invention is made in view of the above-mentioned problems owned by the conventional technologies. The object of the present invention is to realize a manufacturing method of an image display apparatus of sufficient outgas at a time of vacuum exhaustion. Also the object of the present invention is to realize a manufacturing method of an image display apparatus of capability to increase image quality of an image display apparatus and of long life.

[0015]

[Means to Solve the Problem]

A manufacturing method of an image display apparatus of the present invention comprises a first process to bake an envelope and to vacuum exhaust via an exhaust pipe at the same time, the envelope including the exhaust pipe which communicates to outside and in which image display members are disposed, and a second process to seal the exhaust pipe to maintain vacuum of the inner space after the vacuum exhaustion by the first process. The temperature for baking the exhaust pipe in the first process should be the temperature for baking the envelope or more.

[0016]

In this case, the temperature for baking the exhaust pipe may be the softening point of the exhaust pipe or lower.

[0017]

[Operation]

In the present invention, baking performed in the first processing along with the vacuum exhaustion is also performed not only on the envelope but also on the exhaust pipe. The temperature for baking the exhaust pipe at this stage is set higher than the temperature for baking the envelope. Accordingly, the vacuum level reduction and the ambient atmosphere change in the image display apparatus due to the outgas produced when the exhaust pipe is sealed will not occur.

[0018]

If the temperature of the exhaust pipe is set at the softening point of the exhaust pipe or higher, shape of the exhaust pipe will change and will obstruct the consequent sealing operation. But if the temperature of the exhaust pipe is set around the softening point and at the same time is set at the softening point or lower, the amount of the outgas generation is minimized. Then this temperature setting can prevent sealing operation from losing its easiness.

[0019]

[Embodiment]

Herein, embodiments of the present invention will be described with reference to the drawings.

[0020]

Fig. 1 is a cross-sectional view showing the constitution of the image display apparatus manufactured by the manufacturing method of the present invention.

[0021]

In Fig. 1, reference numeral 106 denotes a face plate, and a transparent conductive film 107, a phosphor 108 and a metal-back 109 are formed thereon. Reference numeral 101 denotes a rear plate. The rear plate composed of an insulating substrate where a plurality of electron beam generating devices are disposed. And the electron beam generating device is composed of device electrodes 104 and a fine particle film 105, which is provided between the device electrodes 104. The rear plate 101 constitutes the image display member together with the face plate 106. The rear plate 101 is loaded with a plurality of the above-mentioned electron beam generating devices via an electrode 102 for control and an insulating layer 103. Reference numeral 111 denotes a frame member, and forms an envelope by welding with the face plate 106 and the rear plate 101 via an adhesive agent 112. Also, reference numeral 110 denotes an exhaust pipe for vacuum exhaustion, and it is communicated into the envelope through the frame member 111.

[0022]

With regard to the frame member 111, the rear plate 101 and the face plate 106 in the manufacturing method of the present invention, they may be formed with any material as long as it has an insulating property. But it is preferable that such material is selected in substantially same coefficient of thermal expansion. Specifically, such material should be a glass substrate of soda lime glass, quarts and the like and a ceramic substrate of Al_2O_3 and the like.

[0023]

With regard to the adhesive agent 112, it may be formed with any material as long as it can air-tight adhere the rear plate 101 and the face plate 106 via the frame member 111 so as to seal the inside. Specifically among such materials, a preferable material should be such as a non-crystalline low melting point frit glass and a crystalline low melting point frit glass. Such materials are mixed with an organic solvent, or with a binder such as nitrocellulose and an organic solvent which dissolves the

binder into paste. The adhesive agent 112 of stickiness at least in the temperature for application operation is used. It is needless to say that adhesive agent mixed according to an application method is used.

[0024]

The application method of the adhesive agent 112 may be any of a printing method, a spray method and a dispenser method. The application method which can apply and form a desired amount of desired adhesive agent is acceptable.

[0025]

Subsequently, as shown in Fig. 1, the adhesive agent 112 is formed on the rear plate 101 where electron beam generating devices are formed, and the frame member 111 is disposed on the adhesive agent. On the frame member 111, the adhesive agent 112 is further formed, and the face plate 106 is further disposed on the adhesive agent 112. The above assembled parts are heated and welded at the temperatures ranging, for example, approximately from 350℃ to 650℃, where the low melting point frit glass used in adhesive agent 112 melts. Pressure is applied on the face plate 106 or the rear plate 101 as occasion demands. After the process described above, heating is performed using a heating device as shown in Fig. 2 and Fig 3.

[0026]

Next, the heating processing in the present invention is described with reference to Fig. 2 and Fig. 3.

[0027]

In Fig. 2 and Fig. 3, reference numeral 214 denotes a display apparatus constituted as shown in Fig. 1, numeral 213 denotes the heating device and reference numeral 215 denotes an exhaust pipe heating device.

[0028]

At the heating processing, the display apparatus 214 formed with the rear plate 101, the face plate 106 and the frame member 111 is heated on the heating device 213 as shown in Fig. 2 and Fig. 3. The inner air of the display apparatus 214 is exhausted through an exhaust pipe 210 (the exhaust pipe 110 in Fig. 1), thus obtaining a desired vacuum.

[0029]

With regard to the heating method, any device or method of a bak-

ing furnace, an infrared heater, a hot plate and the like may be used if the temperature for heating the display apparatus 214 and the temperature for heating the exhaust pipe 210 are the same level.

[0030]

Also, in order to heat the exhaust pipe 210 at a higher temperature than the display apparatus 214, an exhaust pipe heating device 315 is used, thus heating to a desired temperature.

[0031]

With regard to the exhaust pipe heating device 315, a winding heater, a ribbon heater, an induction heating and the like may be used. Any device or method may be used as long as they can heat at a desired temperature.

[0032]

With regard to the temperature for heating the display apparatus 214 and the exhaust pipe 210, the heating may be performed within a range of small change among the outgas at time of sealing of the exhaust pipe, the vacuum level or the ambient atmosphere by the outgas from the display apparatus 214 after sealing. For example, heating is performed at temperatures ranging approximately from 120℃ to the softening point or lower of the exhaust pipe. The amount of outgas generated at the time of melting and sealing of the exhaust pipe can be minimized by setting the heating temperature around the softening point of the exhaust pipe.

[0033]

If the temperature of the exhaust pipe is set at the softening point of the exhaust pipe or higher, the shape of the exhaust pipe will change and will obstruct the consequent sealing operation. But if the temperature of the exhaust pipe is set at around the softening point and at the same time is set at the softening point or lower, the amount of the outgas generation is minimized. Then this temperature setting can prevent sealing operation from losing its easiness.

[0034]

Subsequently, the exhaust pipe 210 thoroughly heated and exhausted is further heated and melted, then manufacturing the image display apparatus.

[0035]

As described above, according to the manufacturing method of the present invention, the vacuum sealing of the image display apparatus with a minimum amount of outgas generated at the time of sealing of the exhaust pipe is performed.

[0036]

Note that with regard to the electron beam generating device formed on the rear plate 101 as shown on Fig. 1, there are a vacuum fluorescent display tube using a filament type thermion ic electron source, a plasma display using discharge and a cold cathode which is classified into a bulk type and a thin film type.

[0037]

For example as a bulk type cathode, FE [W. P. Dyke & W. W. Dolan, "Field emission", Advance in Electron Physics, 8, 89 (1956)], an Avalanche type or NEA type semiconductor [J. A. Burton, "Electron emission from silicon", Phys. Rev., 108, 1342 (1957)] or MgO ["Tung-sol confirmscold cathode tube", Electronics News (26, Jan. 1959)] and a photo cathode are known.

[0038]

On the other hand, for example as a thin film type cathode, there are MIM [C. A. Mead, "The tunnel-emission amplifier", J. Appl. Phys., 32, 646 (1961)], a spindt type [C. A. Spindt, "Physical properties of thin-film fieldemission cathodes with molybdenum cones", J. Appl. Phys., 47, 5248 (1976)] or a surface conductive type electron emitting device [M. I. Elinson, Radio Eng. Electron Phys., 10, (1965)].

[0039]

The surface conductive type electron emitting device utilizes a phenomenon of electron emission. The electrons are emitted when current is made to flow in parallel in a film of the small area of thin film formed on substrate.

[0040]

As the surface conductive type electron emitting device, an element using SnO_2 (Sb) thin film developed by the above-mentioned M. I. Elinson and so on, an element using Au thin film [G. Dittmer:"Thin Solid Films", 9, 317 (1972)], an element using ITO thin film [M. Hartwell and C. G. Fonstad: "IEEE Trans. ED Conf.", 519 (1975)] and an element using a carbon thin film [Araki Hisashi et al.: Shinku(Vacuum), Volume 26, no. 1, on pp. 22

(1983)] are reported.

[0041]

In addition, in Japanese Patent Laid-Open No: Hei 1-200532 gazzet and Hei 2-56822 gazzet, a surface conductive electron emitting device is described, where fine particle films are disposed between electrodes, and electron emitting portions are formed by performing an electric conduction processing. Any of above-mentioned electron emitting devices may be used.

[0042]

Next, the manufacturing method according to the present invention will be specifically described with reference to Fig. 1, Fig. 2 and Fig. 3.

[0043]

(Embodiment 1) The image display apparatus as shown in Fig. 1 and Fig. 2 was manufactured as follows.

[0044]

A soda lime glass was used as the rear plate 101. After thoroughly cleaning the rear plate, the electrode 102 for control and the insulating layer 103 were formed by a vacuum evaporation technology and the photolithography technology. Subsequently, as shown in a top view and a front view of Fig. 4 (a) and (b), the device electrodes 104 made of Ni were formed. At this stage, the distance between the device electrodes L_1 was made in 3 μ m, the width of the device electrode W_1 was made in 500 μ m and its thickness d was made in 1000 Å.

[0045]

(2) After applying an organo palladium contained solution (ccp-4230 made by Okuno Chemical Industries Co., Ltd.) on a predetermined portion, a heating processing is performed at 300℃ for 10 minutes, and the fine particle film 105 made of a palladium oxide (PdO) fine particle (average particle size: 70 Å) was formed. The width (the width of the element) W was made in 300 μ m, and the film was disposed around the center area of the device electrode. Also, the thickness of the film was 100 Å, and the sheet resistance value was $5 \times 10^4 \Omega/\square$.

[0046]

Note that the fine particle film mentioned here is the film where a plurality of fine particles gathered. As a fine structure, not only a film where fine particles are dispersed individually but also a film of status

where fine particles are adjacent or layered each other (including island status) are included. The particle size means a recognizable size in the above-mentioned status of the fine particles.

[0047]

(3) Next, a soda lime glass was used as the frame member 111, the exhaust pipe was formed in the predetermined position, thus welding and forming the exhaust pipe 110 made of the soda lime glass.

[0048]

(4) Then a solution was obtained by dissolving a low melting point glass (S-3081, manufactured by Nippon Electric Glass Co., Ltd.) and ethyl cellulose into a solvent, and by using a dispenser, the solution was applied and formed on the contacting surface of the frame member 111 with the rear plate 106 and the face plate 101.

[0049]

(5) Subsequently, the rear plate 101 where the electron beam generating device was formed, the frame member 111 and the face plate 106 were disposed and laminated in the predetermined position, pressurized by a weight of 1kg from above, and were baked at the temperature for sealing heat processing of 410℃ and in the sealing heat processing time of 60 minutes under the atmosphere, thus forming the image display apparatus.

[0050]

(6) Next, a vacuum exhaustion was performed to the level of 1×10^{-6} torr through the exhaust pipe 110, a voltage was applied between the device electrodes 104, and the fine particle film 105 was subjected to electric-conduction processing (forming processing), thus manufacturing an electron emitting portion 401 (refer to Fig. 4).

[0051]

Further, the surface conduction electron emitting device used in the present invention is described more in detail as follows. As the fine particle film 105 including an electron emitting material, a film of conductive fine particles with the particle size from ten to nineteen Å to a few μm or a carbon thin film where such conductive fine particles are dispersed are listed. Among such materials, specific examples are listed as follows. Metal such as Pd, Ag, Au, Ti, In, Cu, Cr, Fe, Zn, Sn, Ta, W and Pb; oxide conductive body such as PdO, SnO_2, In_2O_3, PdO and Sb_2O_3; boride such as

HfB_2, ZrB_2, LaB_6, CeB_6, YB_4 and GdB_4; carbide such as TiC, ZnC, HfC, TaC, SiC and WC; nitride such as TiN, ZrN and HfN; semiconductor such as Si and Ge; carbon; AgMg; NiCu; PbSn, and so on. These films are formed by a vacuum evaporation method, a spattering method, a chemical vapor deposition, a diffusion application method, a dipping method or a spinner method.

[0052]

Still further, with regard to the structure of the electrode 102 for control, the electrode was formed on the back surface of the electron beam generating portion for control as manufactured according to the embodiment. But there are other structures where a control electrode having passage holes for electron is disposed on the electron beam generating portion and a simple matrix structure.

[0053]

(7) Next, as shown in Fig. 2, the display apparatus 214 manufactured as described above, by using a baking furnace as the heating device 213, underwent a heating processing with the exhaust pipe 210 at the heating processing temperature of 200℃ and the heating processing time of 10 hours along with a vacuum exhaustion through the exhaust pipe 210. The exhaust pipe 210 was heated, melted and sealed, thus forming the image display apparatus.

[0054]

As described above, with regard to the image display apparatus manufactured according to the manufacturing method of the present invention, the apparatus 214 and the exhaust pipe 210 undergo the heat processing and outgas at the same temperature. Accordingly, the amount of the outgas at time of sealing the exhaust pipe which was performed subsequently could be reduced, and the image display apparatus could be formed without reducing the vacuum level in the display apparatus.

[0055]

When the image display apparatus was driven and operated, there was no discharge of the high voltage applied between the rear plate 101 and the face place 106, and the image display apparatus of high durability could be obtained.

[0056]

(Embodiment 2) Next, with regard to heating of the exhaust pipe

210 at a higher temperature than the display apparatus 214, description is made with reference to Fig. 3.

[0057]

In the case of the present embodiment, the display apparatus 214 was manufactured in the same manufacturing method as the first embodiment, except that a hot plate was used as the heating device 213 and the exhaust pipe 210 underwent the heating processing by the exhaust pipe heating device 215. Also, a winding heater was used in the exhaust pipe heating device 215.

[0058]

In the present embodiment, the heating processing was performed under the temperature of 160℃ for heating the display apparatus 214 and 300℃ for heating the exhaust pipe 10, and the heating processing time of 8 hours.

[0059]

As a result, despite that the temperature for heating processing of the display apparatus 214 was lower than that of the first embodiment, the effect as same as the first embodiment was confirmed.

[0060]

(Embodiment 3) In this embodiment, a vacuum fluorescent display tube using a filament was employed as the display apparatus. And the display apparatus was manufactured in the same manufacturing method as the first embodiment except that the temperature for heating processing was set at 350℃ and the processing time was 1 hour (not shown).

[0061]

As a result, in spite of the difference of the electron beam generating device formed on the rear plate, the temperature for heating processing and the processing time, the effect as same as the first embodiment was confirmed.

[0062]

(Embodiment 4) In this embodiment, the structure using a plasma generating device as the display apparatus was employed. And the display apparatus was manufactured in the same manufacturing method as the second embodiment except that the temperature for heating processing of the apparatus was set at 300℃, the temperature for heating processing of

the exhaust pipe was set at 400℃ and the processing time was 2 hours (not shown).

[0063]

As a result, in spite of the difference of the electron beam generating device formed on the rear plate, the temperature for heating processing and the processing time, the effect as same as the second embodiment was confirmed.

[0064]

(Embodiment 5) In this embodiment, the apparatus was manufactured in the same manufacturing method as the first embodiment except that a voltage was applied on the device electrodes after the heating processing of the apparatus and the exhaust pipe, and the fine particle film was subjected to an electric-conduction processing (forming processing), thus forming the electron emitting portion (not shown).

[0065]

As a result, in spite of the difference of the manufacturing processing of the heating processing and the electrical-conduction processing, the effect as same as the first embodiment was confirmed.

[0066]

(Embodiment 6) In this embodiment, the apparatus was manufactured in the same manufacturing method as the second embodiment except that a voltage was applied on the device electrodes after the heating processing of the apparatus and the exhaust pipe and sealing the exhaust pipe and the fine particle film was subjected to the electrical-conduction processing (forming processing), thus forming the electron emitting portion (not shown).

[0067]

As a result, in spite of the difference of the manufacturing method of the heating processing and the electric-conduction processing, the effect as same as the second embodiment was confirmed.

[0068]

(Embodiment 7) In this embodiment, the apparatus was manufactured in the same manufacturing method as the second embodiment except that a ribbon heater was used as the exhaust pipe heating device 215 (not shown).

[0069]

As a result, in spite of the difference of the exhaust pipe heating device 215, the effect as same as the second embodiment was confirmed.

[0070]

(Embodiment 8) In this embodiment, the apparatus was manufactured in the same manufacturing method as the second embodiment except that a high frequency induction heating device was used as the exhaust pipe heating device 215 (not shown). Note that, in this embodiment, a frequency of the high frequency induction heating device was set at a certain level so as to heat the whole body of the exhaust pipe 210.

[0071]

As a result, in spite of the difference of the exhaust pipe heating device 215, the effect as same as the second embodiment was confirmed.

[0072]

Note that, in the case of this embodiment, a specified gas molecule can be heated by adjusting the frequency to be set. Accordingly, a kind of gas can be selected for outgas at a time of sealing of the exhaust pipe 210, and it is effective in performing a careful sealing operation in accordance with a quality of the constituting members of the exhaust pipe and the adhesive agents.

[0073]

[Effects of the Invention]

Since the present invention is constituted as mentioned above, the effects as follows are achieved.

[0074]

In the method described in the claim 1, heating processing is performed in the temperature for baking the exhaust pipe being set at the same temperature or higher as the temperature for baking the apparatus. After the heating processing, the image display apparatus is manufactured by the process of sealing the exhaust pipe. Because of this method, the following effects are achieved.

(1) Sealing can be performed without reducing the vacuum level and the ambient atmosphere inside the apparatus.

(2) Deterioration of the apparatus due to high voltage discharge and the like decreases, and yield increases.

(3) Change of a driving voltage and deterioration of durability of the apparatus decrease, thus increasing the quality stabilization for a long life.

[0075]

In the method described in the claim 2, generation of the outgas can be minimized at the same time preventing sealing operation from losing its easiness. Therefore, it is efficient in further increasing the above-mentioned effects.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a typical cross-sectional view of an example of the image display apparatus manufactured by the manufacturing method of the present invention.

[Fig. 2]

Fig. 2 is a typical cross-sectional view of an example of the manufacturing method of the present invention.

[Fig. 3]

Fig. 3 is a typical cross-sectional view of another example of the manufacturing method of the present invention.

[Fig. 4]

(a) and (b) are a top view and a front view of the electron beam generating device respectively manufactured by the present invention.

[Fig. 5]

Fig. 5 is a typical fragmentary sectional view of an example of the image display apparatus manufactured by the conventional method.

[Fig. 6]

Fig. 6 is a typical fragmentary sectional view of another example of the image display apparatus manufactured by the conventional method.

[Fig. 7]

Fig. 7 is a typical cross-sectional view of an example of the conventional manufacturing method.

[Description of Reference Numerals]

101: Rear plate

102: Electrode

103: Insulating layer

104: Device electrode

105: Fine particle film
106: Face plate
107: Transparent conductive film
108: Phosphor
109: Metal back
110: Exhaust pipe
111: Frame member
112: Adhesive agent
210: Exhaust pipe
213: Heating device
214: Display device
315: Exhaust pipe heating device
401: Electron emitting portion

FIG. 1

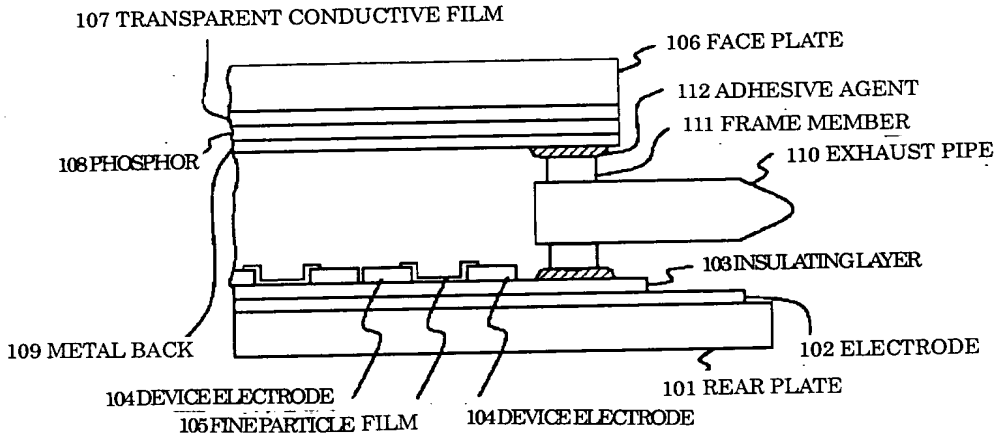


FIG. 2

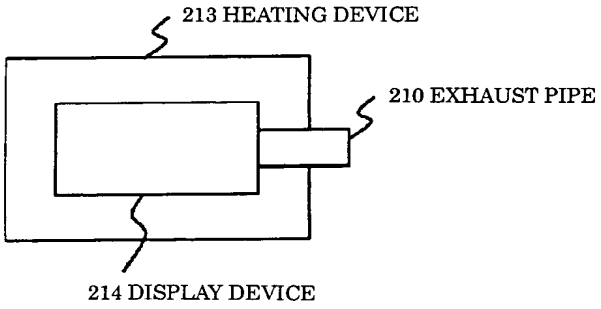


FIG. 3

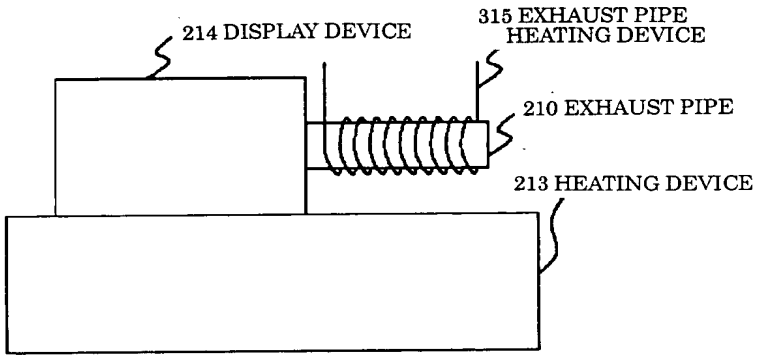


FIG. 4

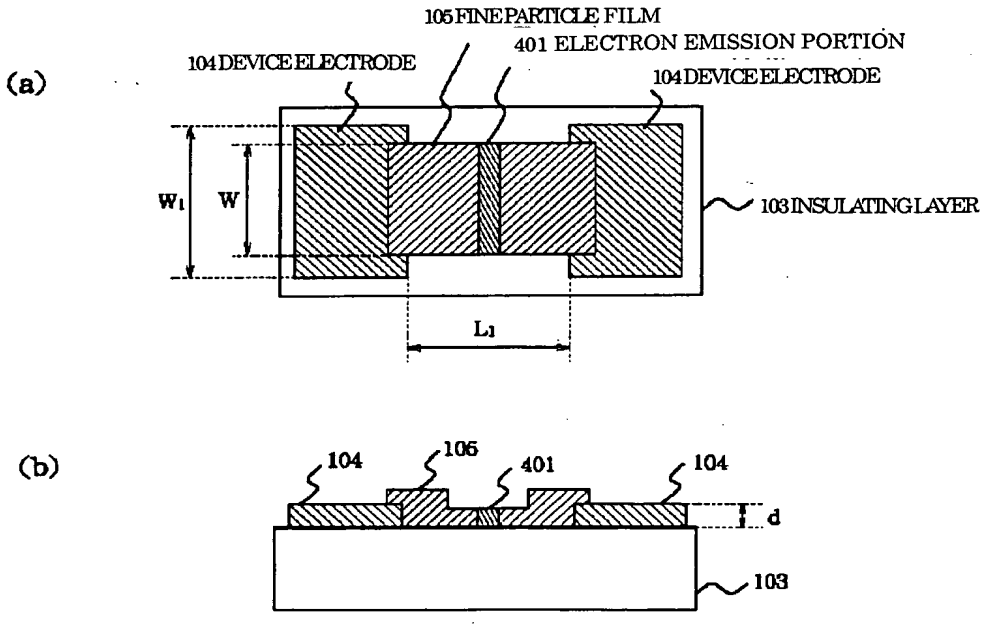


FIG. 5

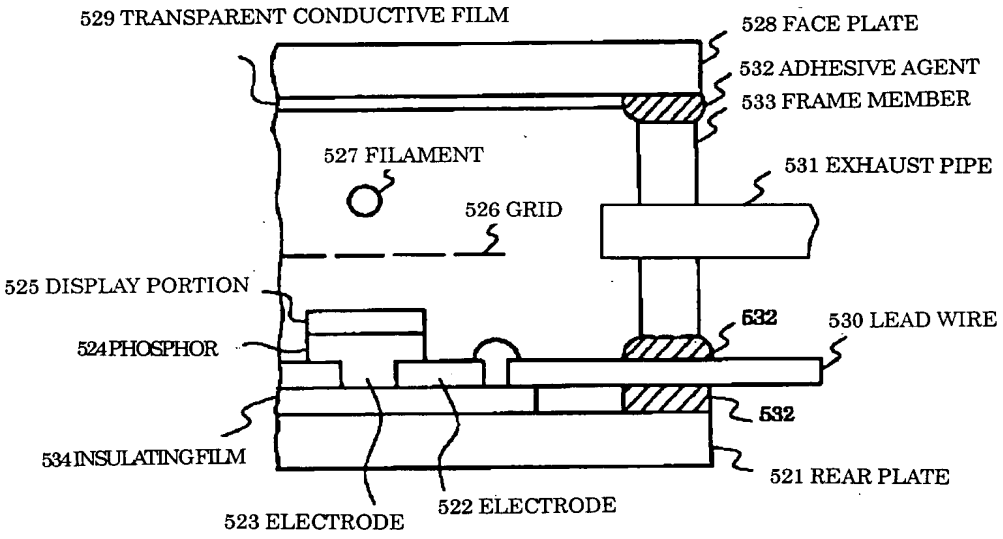


FIG. 6

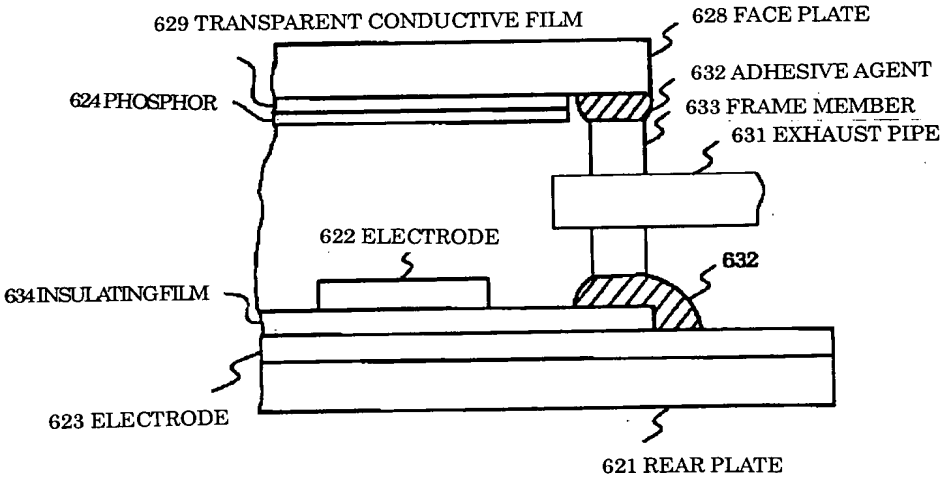


FIG. 7